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ABSTRACT

This report reviews three science teacher education programs: the Iowa-UPSTEP program (Undergraduate Pre-Service Teacher Education Program), the STEP program (Science Teacher Education Project) in Great Britain, and the science teacher education program at the Hebrew University, Jerusalem. Recommendations are made for incorporating some aspects of the two latter programs into the Iowa-UPSTEP program. (MLH)

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The University of Iowa

March 1976

technical report 9

THE IOWA-UPSTEP PROGRAM IN INTERNATIONAL PERSPECTIVE

by

Pinchas Tamir

The Technical Report Series

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THE IOWA-UPSTEP PROGRAM IN INTERNATIONAL PERSPECTIVE

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INTRODUCTION

Significant, perhaps revolutionary changes in our conception of the goals of education, the nature of the curriculum, teaching strategies and the structure of the schools have occurred in the last fifteen years. These changes resulted in a whole array of new programs at all levels, especially in science. Gigantic sums of money have been consumed in the design of these new curricula, and yet, it is now generally accepted that the teacher has remained, and in all probability, will continue to be, the key to successful implementation of any program in the classroom. Many different models of teacher education have been developed in an attempt to cope with the perennial problem of the teacher educator who seeks to provide for meaningful and relevant experiences and at the same time is aware that he has to produce a product in the present that must operate in the future. In a recent review of trends in biology teacher education Meyer (1975) indicates that during the last ten years "there has been a rapid change-over from traditional lecture and tutorial methods to a wider range of training styles and strategies"(1). He goes on to identify certain trends regarding the newer strategies. His observations with some revisions and additions are presented below:

1. Training in understanding objectives changes to training in writing objectives, generally expressed (but not always so) in behavioral terms.
2. Extending the time spent in schools and spreading it over the years.
3. Appointing and retraining within-school master teachers and

supervisors to take responsibility for practice-teaching.

4. Extensive use of microteaching both as a means of developing specific competencies and as a vicarious substitute for certain elements of school experience.
5. An appreciation of student differences leads to attempts to match instructional techniques to individuals and groups, e.g., modules, audio tutorials, programmed instruction, multi-media training kits, "contract" method, and the "Keller Plan".
6. The excursion or field trip evolves into training programs for environmental and community analysis, stressing interdisciplinary approaches and involving, at times, extended periods of outdoor camping.
7. Small group work evolves into a study of interpersonal relations and leads to sensitivity training.
8. Classroom observation develops into interaction studies. The evidence obtained through this analysis is used to train and retrain teachers in the application of pupil-oriented strategies. It may also be used as a means for feedback and assessment of the progress of student teachers.
9. The "Teachers' Guide" evolves into special pre-service and in-service training modules for new curricula.
10. Simpler aspects of role playing develop into more sophisticated forms of educational games and other simulations, including computer assisted simulations. Role play situations have been successfully used in training for inquiry teaching, self pacing,

interpersonal relations, the social implications of science, classroom incidents, etc.

11. Strategies which fit a self-contained classroom organization evolve into training for team teaching and open-plan school designs.
12. Project work evolves into genuine research study as a part of the pre-service programs.
13. Assessment by formal examination changes to assessment of the formative development of teaching skills and competencies. The self inventory produced by NSTA and similar inventories are used by pre-service and in-service teachers to evaluate their own competencies.
14. Stress on cognitive aspects of teaching changes to training for personal adjustment, self concept, values and attitudes toward issues such as inquiry teaching and science-related social problems.
15. Inquiry and problem solving emphasis enlarges its perspective to include training for creativity and divergent thinking.
16. Analysis of given courses of study changes to development of skills of curriculum construction with special emphasis on the use of materials developed by different curricula in designing a new unit.
17. Learning to use resources widens its scope to include training in the production of both printed and non-printed learning resources, such as media and apparatus.

18. Conventional training in communication skills changes to training in making full use of the techniques of educational technology including facilities of the media resource centers of the school and of the district.
19. Pre-service programs allow for increasing involvement of the students in planning their courses and in evaluating the effectiveness of their programs.
20. The study of intellectual development following Piaget's model is becoming an important component in most teacher education programs.

Two more general trends have also been observed by Meyer. The first relates to the increasing awareness that pre-service training is just a first cycle in a continuous process which must be supplemented by further cycles of in-service programs. And second, that there exists a growing dissatisfaction with what he calls the "end-on" approach in which all the training in pedagogy is compressed in two, or even one year at the end of the professional study of science. Concurrent rather than end-on training programs are becoming more and more widespread in various countries.

The concurrent approach has the following advantages:

a) It provides the student with an early opportunity to develop a personal position on certain aspects of teaching and education.
b) It provides an opportunity for students to find out whether they really wish to consider teaching as a career.
c) It allows for closer integration between academic and education areas.

d) It allows for greater flexibility in course structure.

e) In certain cases the science academic programs are designed to be relevant to the teaching needs in terms of objectives, content and method. For example, a strong emphasis has been given in recent years to environmental matters such as pollution, human ecology, and population studies. Some colleges are offering more individualized science courses based, for example, on audio-tutorials or on individual projects.

The interested reader may find more detailed information about "the state of the art" in the education of science teachers in references 1, 2, and 3.

In the forthcoming sections of this report, I shall attempt to describe Iowa-UPSTEP program as I see it. This will be followed by review of science teacher education programs in Israel and in Britain. I shall then try to indicate how UPSTEP can benefit by attending to other teacher education programs and end by offering some specific recommendations based on my observations during my present visit in Iowa.

IOWA-UPSTEP (Undergraduate Pre-Service Teacher Education Program)

Iowa-UPSTEP was conceived with the idea that a new kind of science teacher is needed, a teacher that will be able to cope with the continuous changes in schools in terms of personnel, students, enrollments, relations with the community and the society, as well as goals and objectives. Some of the characteristics of such a teacher are: "(1) preparation in the sciences that includes depth as well as breadth; (2) competencies in the psychological sociological and historical foundations of education; (3) competencies in performing certain skills

needed for a variety of classroom teaching-learning modes; (4) flexibility in personal style that permits coping with change; (5) variety of experiences with people of all ages paralleling experiences leading to greater scientific proficiency; (6) experiences with the creative aspects of science and some specific analyses of the meaning of such experience; (7) an understanding of the philosophy and history of science and experience with the interaction of science and society". (4, p. 497)

The rationale and description of the course are reproduced (with omissions) from reference 5.

> An important part of Iowa-UPSTEP is recruitment in the high schools of Iowa (and the Midwest generally). Secondary Student Training Programs (SSTP) are available for several hundred sophomore and junior high school students for a six week period during the summer. Ultimately most of the UPSTEP participants will have been involved first as participants in one of our Iowa-SSTP Programs prior to selection. Iowa-UPSTEP participants and all SSTP students are outstanding high school students--fully capable of making any vocational choice. Thirty students are identified as UPSTEP students prior to enrollment as freshmen students at the University each fall. They are visited in their high schools. Hopefully, all will have been on the campus for a full summer prior to enrollment as full-time freshmen students as SSTP participants. If they were not SSTP students, they are invited to spend several days on the campus following high school graduation and prior to enrollment as freshmen in the fall. As UPSTEP participants, the students are treated as members of an Honors group for indeed they are Honors students.
>
> The first phase of the Iowa-UPSTEP program provides an opportunity for the participants to meet and interact with some of the most important scientists at the University of Iowa. Weekly seminars are conducted which add to the student experience with various areas of science and various scientists. Such interaction, with persons recognized as leaders in their fields, is a unique experience for freshmen students at the University. The Iowa-UPSTEP participants are invited to visit research laboratories, participate in field excursions, and conduct individual investigations in the several areas of science.

The second phase of year one of the Iowa-UPSTEP program emphasizes problems in communicating science and an analysis of the communicative process itself. The Iowa-UPSTEP staff believes that one of the most important aspects of science teaching is to be able to communicate effectively. Therefore, communication becomes the logical area for investigation for students who are considering science teaching as a career. Potential science teachers should be aware of the methods and modes of communication that are available. A series of weekly seminars demonstrate that different methods are required to communicate with different people at various stages of physical and mental development. The problem of communication in science in "Our Changing Society" ends phase two of the freshman year.

During phase one of the second year of Iowa-UPSTEP, the sophomore students are involved in role playing, simulations, and microteaching experiences involving their peers. Additional inquiry teaching techniques which include the use of audio-visual materials are emphasized. Teacher behavior in the classroom is coded by utilizing a variety of interaction analysis instruments.

Throughout the second phase of the second year, the sophomore students are participating actively in early exploratory experiences in public schools of Iowa City. The purpose of this early exploratory experience is two-fold: first, to provide the opportunity to observe and participate in the duties and responsibilities of teaching in order that a rational decision can be made concerning the suitability of teaching as a career; and second, to provide the student with first-hand experience to insure maximum gain from advanced, professional education course work through the interaction and communication with the cooperating teachers.

The program goals and experiences for the early classroom experience are as follows:

1. Develop insights and skills involved in establishing empathetic relations with school age children and youth.
2. Come to respect and understand each child as a unique person.
3. Gain information about characteristics, interests, needs, and developmental processes of children and youth through observation of their behavior in a variety of settings.
4. Gain insights and appreciation of the social interactions, value systems, environments, and concerns of pupils.

5. Gain knowledge of the way pupils think and learn.
6. Assess potentialities and interests in teaching as a prospective occupation.
7. Secure firsthand experience and knowledge of the organizational structure and inter-personal relationships of the professional staff of public school systems.
8. Gain knowledge and some experiences with instructional processes and media in schools.
9. Develop an appreciation of the inter-relationships and joint responsibilities of teachers and parents in guiding the educational growth of children.
10. Participate in, and become familiar with, professional inter-relationships, activities, and organizations of teachers.
11. Participate in some types of community-school organizations and activities.

Several types of early experiences are available. These are:

1. Observing classroom instruction and procedures.
2. Aiding the classroom teacher with routine clerical and administrative experiences.
3. Assisting in working with individual pupils and small groups in learning situations.
4. Assisting in selecting and preparing learning materials.
5. Assisting in diagnosing learning problems for individual pupils.
6. Assisting in supervision of play activities and some extra-curricular activities.
7. Involvement in parental conferences.

In addition, bi-monthly seminars are held where the Iowa-UPSTEP staff and participants discuss various aspects of the early experiences. Because the early exploratory experience is an experimental program prior to student teaching, several group discussions are conducted in which students, cooperating teachers, and the Iowa-UPSTEP staff collectively evaluate the program.

At the beginning of the junior year, the Iowa-UPSTEP participant is encouraged to apply formally for the teacher education program at the University. At this point, Iowa-UPSTEP participants follow the usual sequence of professional courses--although all of these are specially structured because of the new student needs stimulated by the Iowa-UPSTEP program.

Special new courses have been developed for the junior-senior Iowa-UPSTEP participants. These courses are available for all UPSTEP students--those committed to a teacher education

program, those still undecided about their vocations, and those planning to enter other professions. We find that Iowa-UPSTEP continues to be a viable experience for students with a variety of career goals. In addition, persons not identified previously as UPSTEP participants are invited into the group as science teaching majors. Special courses for the junior year include:

1. One in the student's major field to explore the rationale underlying the organization and presentation of introductory courses.
2. Meaning of Science which considers the elementary philosophy and logic that characterize science.
3. Multi-media Instructional Techniques which provide the students with opportunities to develop and utilize multi-media.
4. History of Science which examines the major steps in the development of twentieth century science.
5. New concepts for secondary schools including computer assisted instruction, learning modules, programmed sequences, open classroom, differential staffing, and new curriculum structures.

Another unique experience of the Iowa-UPSTEP program is the summer institute where Iowa-UPSTEP students interact with experienced high school teachers and graduate students in science education. The summer experience is designed to provide assistance in the preparation of specific teaching materials in each of the major disciplines. The experienced teachers are the cooperating teachers the following academic year for the student teaching experiences. The graduate students are concerned with evaluation and assist with research designs created to evaluate new curriculum materials, new course organization and sequences, and new teaching styles.

During the senior year, the Iowa-UPSTEP participants follow a program similar to the present professional semester at the University of Iowa. Because of the background which the Iowa-UPSTEP students bring to the professional semester, all of the discussions and activities have more meaning and can be dealt with in greater depth. The total program has operated closer to classrooms and teachers. Indeed, one of the major developments is a cooperative program involving men of science, teacher educators, in-service teachers, and real schools as learning laboratories.

The major effort of the last undergraduate seminar is an original research project initiated and supervised in the major science area. Here the UPSTEP students learn what science is through a direct experience. They also gain new experience in communication and in working with people.

The Iowa-UPSTEP students who accept teaching assignments in cooperating midwestern high schools are involved in a three week summer conference following graduation and prior to the commencement of teaching duties. The conference involves former participants in NSF in-service programs, directors, and instructors of similar programs as well as several regular teachers who will be co-teachers the following year with the Iowa-UPSTEP.

The current UPSTEP program is visually outlined in Figure 1.

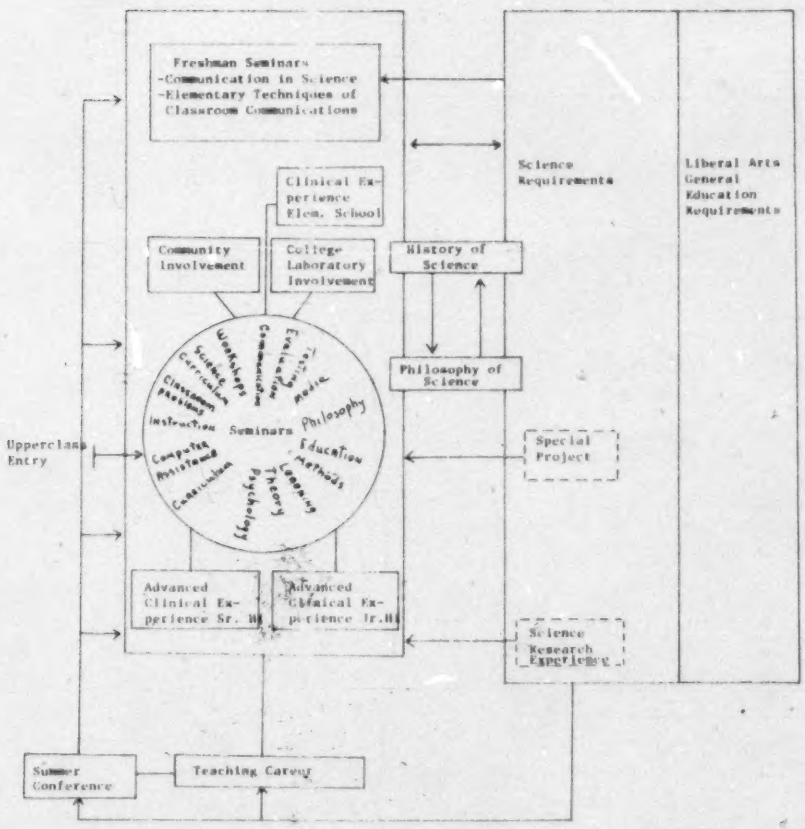

Figure 1

Examination of a large number of science teacher education programs (See references 1, 2, 3) resulted in the list of trends presented in the Introduction. Yet, when one tries to analyze each of these programs separately, very few can be identified in which more than half of these twenty strategies are being employed. The uniqueness of the UPSTEP model lies in its comprehensiveness as evidenced by the employment of all of these twenty evolving strategies. Yet, this comprehensive approach allows for a high degree of flexibility, and leaves room for continuous improvements. Thus, the self-instructional laboratory, the computer assisted simulations, the variety of summer programs and the opportunity to work with several cooperating teachers at several levels are examples of this built-in flexibility. In addition, UPSTEP is continuously interacting with other projects at the Science Education Center thereby creating a variety of opportunities for the student-teachers to interact with high school students in and out of school as well as with inservice teachers. This interaction with inservice teachers is particularly important. Pre-service teachers are not only benefiting by the experience of their inservice mates but at the same time become cognizant of the potential benefits of inservice training. This kind of relationship is bound to develop a more positive attitude of the novice teachers to continuous retraining.

While the model appears to be lying on firm foundations as far as rationale and general design are concerned, certain comments regarding its actual implementation may be helpful. These comments will be presented as recommendations at the end of this report.

THE SCIENCE TEACHER EDUCATION PROGRAM AT THE HEBREW UNIVERSITY, JERUSALEM

In Israel, elementary teachers are trained in teacher colleges, while secondary teachers study in universities. The following description is concerned with the training of high school biology teachers. Undergraduate study in Israel lasts three rather than four years. Student teachers begin their teacher education courses in the third year (which is identical to the junior year in the U.S. and therefore will be referred to as the junior year). A special consideration is given to a balanced preparation as far as biological topics are concerned. It was found that teachers are reluctant to deal with topics for which they did not have adequate preparation in college. Therefore, student teachers are required to take at least one course in each of the following areas: cell biology, microbiology, biochemistry, zoology, botany, plant or animal physiology, plant and animal ecology. In order to obtain a teaching certificate, students have to study for a fourth year which will be referred to as the senior year. Following is a description of courses and assignments in the two years of teacher education.

In the junior year science student teachers participate in the regular education courses offered by the School of Education. Regarding science teaching, they participate in a specially designed course: "Basic Concepts in Science Education". In this course they are introduced to topics such as: science as inquiry, discovery, creativity, advance organizer, educational objectives, invitations to inquiry, science and society, the historical approach to science teaching, and to persons such as: Schwab, Ausubel, Bruner, Gagne, Piaget and Kuhn. Extensive use is

being made of slides, films, single concept loops and ISTEP materials (ISTEP will be described below). Among the assignments in this course are:

a. Critical analysis of a college course, selected by the student. (Objectives, subject matter presentation, the use of the laboratory, assessment, etc.).

b. Analysis of textbook selected by the student using schemes developed after Roden and Romey as well as subjective anecdotal reports.

c. Critical analysis of a research study in science education. The particular study is selected by the student. However, the analysis is performed using detailed instructions relating to the significance of the problem, selection of sample, selection of instruments and other methodological issues. Two less common items are: "What did you like most in this study?" "What is your main criticism of this study?"

This last assignment is considered "tough" by most students, but, in retrospect, they consider it as one of the most valuable assignments, since for most of them this was their first opportunity to read through a professional science education journal and to see what research in education looks like.

Even more important than the course described above is the tutorial group. Each student is assigned to one such group which consists of up to twenty students and an experienced high school teacher acting as a tutor. This tutor is currently teaching in high school, but at the same time hired as a part-time university instructor. There exists no special

syllabus for the weekly tutorial meetings. Many of them will take place in the high school, while others will be based on ISTEP materials or any other topic. While the specific curriculum of this tutorial course is designed by the tutor in cooperation with the students to meet their individual needs, a basic guideline is: avoid lectures, use activities. Visits to schools, classroom interaction analysis, group activities, and simulation games are some examples of what is happening in these informal courses.

In the senior year the students continue with clinical experiences in their tutorial groups, but often the tutors change, so that the students have a chance to interact with another experienced teacher. The tutor is also responsible for the arrangements for practice teaching--he contacts the cooperating teachers and keeps track of the progress of his students. He is also responsible for providing field experiences. The Method Course consists of three parts each taught by a different instructor.

PART A

The class meets weekly during the whole year. The first term is devoted to microteaching using invitations to inquiry which are taught to volunteering high school students (see reference 6 for a more detailed description). This microteaching experience usually precedes the actual practice teaching, thereby providing some preparation for the real life experience. However, it is not less valuable to students who had some teaching experience. The remaining two terms (altogether there are three terms in one academic year) are devoted to a variety of topics,

such as field work, teaching slow learners, getting familiar with available curricula for junior and senior high schools, the use of educational television, assessment and evaluation. Especially interesting and rewarding is the participation of the student teachers as examiners in the practical laboratory matriculation examinations (for which they are paid by the Ministry of Education).

The following are the assignments in this method course:

a. Preparing and microteaching an invitation to inquiry. Analyzing microteaching lessons.

b. Characterizing the teaching style of a selected teacher using at least two observation instruments and a subjective anecdotal account, based on at least three lessons.

c. A report on one high school student based on close observation, direct interactions and information obtained through this classroom teacher and other sources.

d. A comprehensive paper on a selected topic. A list of topics is presented but the student-teacher is free to choose his own topic even if it is not included in that list. The paper may either be based on literature review or report an empirical study. Often these empirical studies are performed by teams of two or three students. Some of the topics from last year were: a) Achievements and limitations of the BSCS program in Israel; b) The conception of "life" by children in different levels of intellectual development; c) Which biological topics are more interesting to high school students?; d) What are the chemistry concepts pre-requisite to the study of biology in the

9th and the 10th grades?; e) How do teachers and students view the various parts of the matriculation examination?; f) What are the attitudes of high school students to verification vs. investigative laboratories?

At the end of the year the students sit for a final examination. This is an open-book examination, testing for general facility in topics such as curricula, assessment, intellectual development, construction of learning tasks and decision making in a variety of classroom situations.

PART B

The second term (three weekly hours) consists of a laboratory course designed to give the students an opportunity to familiarize themselves with selected high school laboratory activities, practice with designing and preparing laboratory activities and actually teaching in the laboratory (both peer-teaching and teaching to volunteering high school students). This course was designed to meet the deficiencies obtained by feedback with regard to the prevailing college laboratory courses which fail to meet the needs of inquiry oriented laboratory instruction. The students in this course work in teams. Each team is responsible for preparing and presenting one laboratory lesson.

PART C

The third term (two weekly hours) consists of a course in the use of educational technology and design of self-instructional units employing audio-visual aids. The students work in teams and design a unit which includes a statement of objectives, the actual instructional sequence and assessment activities. Most units are actually tried with high school

students, but often there is not enough time to improve the materials on the basis of the obtained feedback.

An attempt is made to provide the pre-service teachers with experiences related to the reality of their profession. The following features of the program help to achieve this goal:

a. The tutors are experienced teachers. Through them the pre-service teachers also meet with other experienced teachers.

b. Student-teachers are encouraged to help high school students in their individual projects.

c. Pre-service teachers are invited to participate in in-service courses.

d. Pre-service teachers subscribe to the Biology Teachers' Bulletin.

e. Close connections are created between student teachers and their cooperating teachers.

THE STEP PROGRAM IN BRITAIN

Perhaps the most innovative and potentially most effective approach to the improvement of teacher education is the one developed by the Science Teacher Education Project in Britain. This project, initiated in the early 1970's and supervised by persons who had been actively engaged in the high school science reform movement, may be conceived as a response to the growing feeling among many people that the course materials developed in the 1960's would not be able "to bring about the changes in teaching style on which their success depends" (7, p. 9). The key feature of this project was the formation of a community of tutors extending

across many institutions who shared a common interest in improving their 'method' courses by adapting them to the needs of prospective science teachers. More than 200 tutors all over Britain participated by either contributing ideas and activities, or by trying and providing feedback on trial units, or both. As a result of this cooperative effort 160 activities were actually tried, of which 97 appear in the final product. These activities may be characterized as follows:

a. They are concerned not with the content of science but with pedagogy--i.e., methods of teaching and related aspects of psychology, sociology, and philosophy.

b. They involve the students in activity--e.g., small group discussion, analysis of tape recordings or of films of parts of lessons, team planning, team teaching, writing, teaching small groups, testing children, testing oneself, observing-recording and analyzing classroom interactions, role playing, etc.

c. They are short--often not more than 1-1/2 hours--and sufficently self-contained to be used independently of one another.

d. They carry a note on objectives, expressed in terms of qualities or skills that may be enhanced in students. Users are asked to look for behavioral symptoms of these qualities.

e. Many of them use resource materials such as films, videotapes, audiotapes, and slides.

A conscious effort has been made in the STEP activities to show wherever possible how theoretical matters bear on actual classroom practice. In referring to activities the student is conceived at being

active mentally and sensitive emotionally, practicing skill and experiencing the results of doing so. A range of activities is preferred for the following reasons: a) a large range of activities is likely to bring about achievement of more sophisticated objectives; b) a course which offers a variety of experiences is more likely to tap the interest and involvement of more students; c) lectures rarely provide feedback to the tutor while activities have a higher chance of two-way communication; d) if, in the words of Marshall McLuhan, the medium is the message, then we may expect that if the college studies take the students out to explore the local environment, offers them a variety of laboratory experiences, get them using tape-recordings and broadcasts and allow them to move from group discussion to individual project work, they will 'pick up' this too, as incidental learning.

A wide array of resource materials have been produced by the project. These include videotapes, audiotapes, films, film loops, photographs, case studies including classroom critical incidents, collated pupil writings, reprints of articles in science education, and single page worksheets, observation records and study guides. The tutor is thus supplied with a rich collection of resource materials, supportive reading and background material which may be directly related to specific activities (See Fig. 2 and curriculum unit outline).

Specific publications of the Science Teacher Education Project include:

1. Activities and Experiences forms a bank of ideas for professional courses. It is not a course, but a source book for tutors to draw upon when planning courses in the college

and university. It is loose-leafed. Worksheets and data sheets which can be photocopied for distribution to students carry a copyright waiver. Tutors' materials include notes on suggested ways of handling each activity, incorporating users' comments from the trials.

2. Theory into Practice similarly forms a bank of ideas for activities in school. It describes observation exercises and other short studies aimed at helping the student-teacher to make the most of his experience in the school, and which provide material for discussion with his supervisors. There are studies of questioning technique, of how to improve a lesson introductio of the process of establishing control, of the pupils' understanding of teachers' language, of homework and marking, of the realistic planning of practical work, and many more. This book is of especial interest to teachers who supervise students on practice and in their probationary year.
3. Meadowbank School (Editor R. Schofield), describes problems and events occurring in the science department at Meadowbank. They provide stimulus material for discussion and for simulation exercises.
4. Through the Eyes of the Pupil (Editors C. G. Carre and J. O. Head) is designed to help student-teachers to put themselves into pupils' shoes. It is an annotated collection of writings about science by pupils of different ages and abilities.
5. Readings in Science Education (Editors E. W. Jenkins and R. C. Whitfield) collects together important extracts from the

literature on science education and provides a commentary upon them.

6. Videotapes, sound tapes, and slides are available from suppliers listed in Activities and Experiences.
7. Film Review--films for use in professional courses (Editor M. J. Graham). This gives content descriptions of 90 films, with tutors' comments on ways of using them. These are films about different aspects of teaching, not about the content of science.
8. The Art of the Science Teacher is a book for teachers and student-teachers, surveying the main aspects of professional studies. It has one chapter on the background knowledge related to each of the topics shown in the map of professional studies. These chapters raise the main issues that are important in the topic and introduce the literature about it. The authors are the topic group leaders of the project.

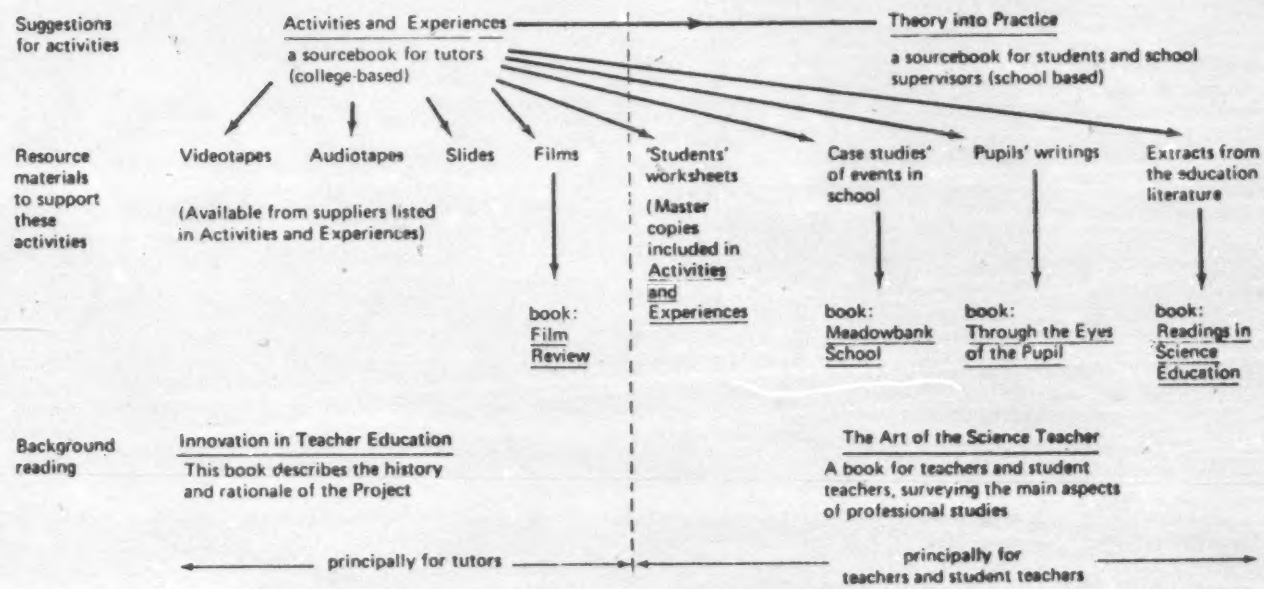
Suggestions for activities
Activities and Experiences
a sourcebook for tutors (college-based)
Theory into Practice
a sourcebook for students and school supervisors (school based)
Resource materials to support these activities
Videotapes
Audiotapes
Slides
Films
'Students' worksheets
(Master copies included in Activities and Experiences)
Case studies' of events in school
Pupils' writings
Extracts from the education literature
(Available from suppliers listed in Activities and Experiences)
book: Film Review
book: Meadowbank School
book: Through the Eyes of the Pupil
book: Readings in Science Education
Background reading
Innovation in Teacher Education
This book describes the history and rationale of the Project
The Art of the Science Teacher
A book for teachers and student teachers, surveying the main aspects of professional studies
principally for tutors
principally for teachers and student teachers

Figure 2

Titles of the curriculum units in Activities and Experiences:

Topic 1. Aims and Objectives

(AIM) 1. Aims are fundamental

2. Analysis of a lesson with oubjectives in mind

3. Valuing objectives: a discussion of priorities

4. Classifying educational objectives

5. What is practical work for?

6. Aims are not everything

7. The teacher's influence on pupils' attitudes and values

Topic 2: The Nature of Science and Scientific Inquir

(SCI) 1. Definitions of science

2. Scientific thinking processes as represented in published courses

3. Is the scientific paper a fraud?

4. Why are atoms in and demons out?

5. The place of science in the whole curriculum

Topic 3: The Pupil's Thinking

(TNK) 1. Children's developing abilities: Classifying

2. Children's developing abilities: Investigating a problem with many variables

3. Attending to what pupils say

4. Attending to what pupils write

5. Patterns of concepts in science courses

6. Concepts at different levels of complexity

7. The influence of teaching style on pupils' thinking

Topic 3 Con't.

8. Getting the feel of learning by doing

9. Getting the feel of learning through words alone

Topic 4: Language in Science Lessons

(Lang) 1. Who will understand what the teacher says?

2. Pupils' use of scientific words

3. Encouraging pupils to learn by talking

4. Writing a good worksheet

5. Encouraging pupils to learn by writing

6. The language of textbooks

7. Textbooks: Elementary ideas and their expression

Topic 5: Teacher-Pupil Interaction

(TPI) 1. Introduction to motivation

2. The teacher's style

3. A sensitivity to pupils

4. Critical incidents

5. Maintaining control

6. The group at work

7. Teacher-pupil interaction: 'Reviewing your stance'

Topic 6: Methods and Techniques

(MT) 1. Identifying with the pupil

2. Different styles of teaching

3. How suitable are various methods for achieving particular aims?

4. Estimating pupils' involvement in different activities

5. Constraints on the choice of method

6. Time for a change?

Topic 6 Con't.

7. Planning class experiments
8. Developing class experiments
9. Improving questioning technique
10. Personal assignments
11. Project work
12. Planning a field trip

Topic 7: Resources for Learning

(RFL)
1. Audiovisual aids: a survey
2. Radiovision in science teaching
3. The use of television science broadcasts
4. Why use film?
5. The use and misuse of visual materials
6. The time needed for assimilation of visual materials
7. The written word
8. Textbook on approval

Topic 8: Adapting to the Pupil

(ADA)
1. Pupils of low ability: some of the problems
2. A closer look at pupils' abilities: Manipulative skills
3. A closer look at pupils' abilities: Powers of expression and writing
4. Can you really estimate ability?
5. Adapting a lesson to particular pupils
6. More flexibility within the lesson
7. Why topic work?
8. Who will teach the slow learner?

Topic 9: Feedback to Teacher and Pupil

(FTP) 1. Ways of finding out what is understood

2. A teacher's oral questions

3. What is being tested in the examination?

4. Devising a good examination question

5. Designing an examination paper

6. Marking

7. Item analysis

Topic 10: Curriculum Design

(CD) 1. Designing a learning experience

2. Exploiting a learning situation

3. Planning a lesson

4. Designing a sequence of lessons

5. Teaching a topic (in small groups)

6. Reviewing a published course

7. Integrating the sciences

Topic 11: Safety

(SAF) 1. So you think you know all about safety?

2. After the accident...

3. Spot the hazard

4. Case histories of accidents

5. Some experiments which need rehearsal

Topic 12: Laboratory Design and Management

(LDM) 1. Viewing many laboratories

2. Storing materials

3. Distributing and collecting materials

Topic 12 Con't.

4. Ordering materials
5. 'Alivo': Looking after small mammals
6. Designing simple apparatus
7. Coping with the information explosion
8. Understanding the technician's point of view

Topic 13: The Social Context of Science Teaching

(SOC) 1. Problems of teaching in a comprehensive school
2. To stream or not to stream
3. The alternative road in further education
4. A fair share of the cake
5. Public examinations: For better or for worse?
6. The social and moral consequences of science
7. Essentials for the life of the community

Titles of the school-based activities in Theory into Practice

Section 1: Understanding your Pupils

1. Extablishing control
2. Maintaining control
3. A little bit of encouragement
4. Ways of engaging pupils' interest and effort
5. The desire to learn
6. Exploring how pupils think
7. Who can think in the abstract?
8. Listening to pupils
9. 'Give us a for-instance'
10. Pupils' use of scientific words

Section 2: Developing Your Teaching Skills

11. Adapting your language: who will understand what you say?
12. Classroom talk: an exploration of teaching styles
13. Improving your questioning technique
14. Thirty thousand questions a year!
15. Looking at a lesson in terms of its purposes
16. How to get better and better at teaching
17. Impression marking
18. Time for a change?
19. Discerning danger
20. On-the-spot decisions
21. What makes a good teacher?

Section 3: Preparing Your Lessons

22. Starting a lesson: the first few minutes
23. Planning a class experiment
24. Planning a demonstration experiment
25. Organizing group discussions
26. Write it up for homework!
27. The range of pupil activities available to you
28. Planning a lesson

Section 4: Considering the Context of your Work

29. Have you got your priorities right?
30. Coming to terms with reality
31. A fair share of the cake
32. How much will the next six lessons cost?
33. Making the best use of the laboratory you work in

A map of professional studies. Questions and topics to consider in the planning of a teacher's work

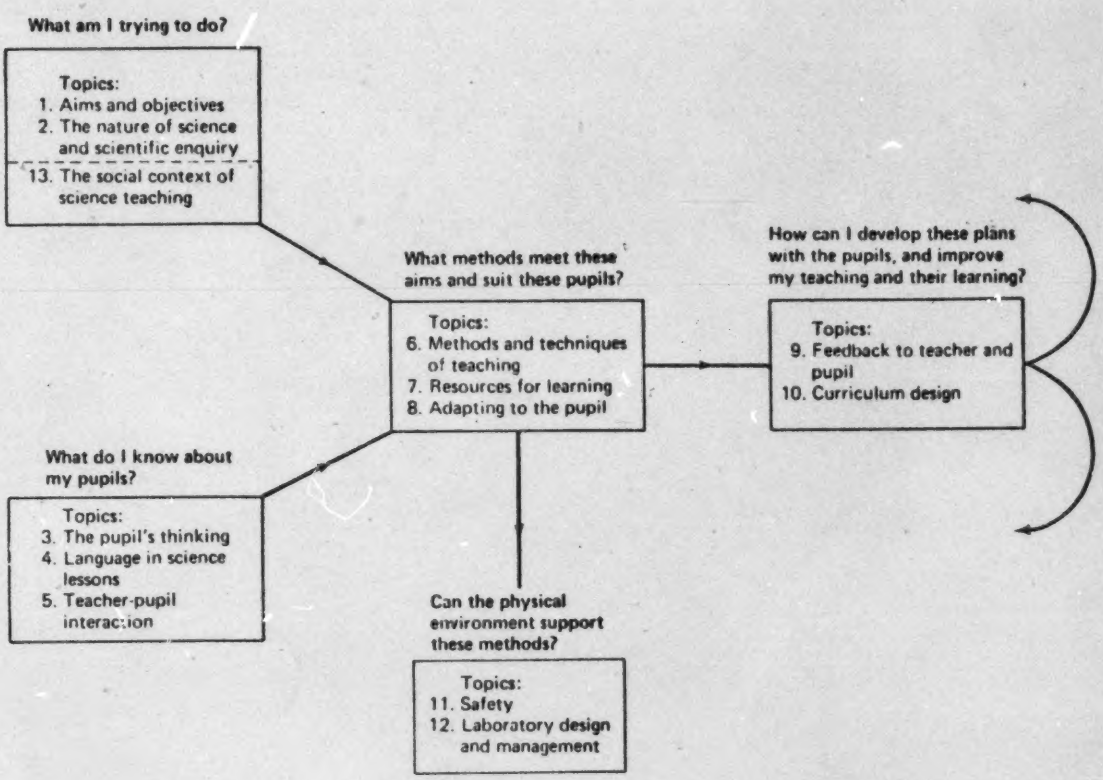
What am I trying to do?
Topics:
1. Aims and objectives
2. The nature of science and scientific enquiry
13. The social context of science teaching
What methods meet these aims and suit these pupils?
Topics:
6. Methods and techniques of teaching
7. Resources for learning
8. Adapting to the pupil
How can I develop these plans with the pupils, and improve my teaching and their learning?
Topics:
9. Feedback to teacher and pupil
10. Curriculum design
What do I know about my pupils?
Topics:
3. The pupil's thinking
4. Language in science lessons
5. Teacher-pupil interaction
Can the physical environment support these methods?
Topics:
11. Safety
12. Laboratory design and management

Figure 3

A map of professional studies is provided as a guidelines for the tutor. (See Figure 3) However, (and this is perhaps the most attractive feature of the program) each tutor is free to choose activities and readings and build his own course to meet his own preferences and the specific needs of his students. A special questionnaire was designed to help the tutor get direct feedback from his students regarding each activity. Following each activity

the student may be asked to rank order the items which relate to this specific activity in order of their importance to him. He is really responding to the question: To what extent was this activity important in helping you to:

1. feel that you will, in fact, cope with the classroom.
2. explore your own capabilities.
3. feel you have achieved success (by your own standards).
4. have new or fresh experience.
5. sort out or express your own ideas and opinions.
6. be liked, or get on with others.
7. help and be helped.
8. feel that your own contribution is appreciated by others.
9. see yourself more clearly as a teacher.
10. feel you have gained practical teaching skills.
11. feel you have developed relevant understanding.

The description presented above is based mainly on reference 7.

The materials published by STEP have been very useful in Britain as well as elsewhere. Over the past two years over 50 science educators around Australia have been engaged in a project (Australian Science Teacher Education Project, ASTEP) to produce their own activities.

A similar project, ISTEP, involving all teacher training institutions has been established in Israel. Members of this cooperative project have been working to adapt the British materials as well as designing original materials to meet the specific needs of Israel.

IMPLICATIONS FOR UPSTEP AND RECOMMENDATIONS

In this section an attempt will be made to show how Iowa-UPSTEP, whose comprehensive model is by far more progressive than most programs now in operation all over the world, may benefit from certain experiences acquired by other teacher education projects. Some of the suggestions relate to the implementation and formative evaluation of the present program and others to the extensions planned for 1975-76, especially with regard to the preparation of modules (Reference 8, 72-75). A special reference will also be made to some managerial aspects and to long-term evaluation.

1. Many of the activities and assignments currently operating in Iowa-UPSTEP may be used for student assessment as well as for program evaluation. For example, the computer assisted interactive incidents are especially suitable for this purpose.
2. Some of the activities and assignments which have proved to be operational and valuable in Israel may be incorporated into the present UPSTEP program. These are listed below with an attempt to allocate each of them to a particular year in the UPSTEP program.
   a. Analysis of a college science course (freshman).
   b. An interview with a scientist trying to obtain hiw view of the nature of science (sophomore).
   c. Analysis of research report in science education (junior).
   d. Textbook analysis (junior).
   e. Microteaching using invitations to inquiry (junior).

f. Carrying out a limited study of selected aspects pertaining to the learning of science (by terms of two or three students) (senior).

g. Working through a self instructional module on practical laboratory examinations (Such a module was designed by the author and donated to UPSTEP; it may fit the junior year).

3. Some of the STEP activities may be adopted or adapted for various phases of the UPSTEP sequence. The Israeli experience in similar undertakings revealed that general areas such as the nature of science or objectives, are more suitable for that purpose than other areas, such as classroom incidents, or teacher behavior which are much more culture dependent. In general, the variety of response formats characteristic for the STEP program may provide a significant improvement over the small and large group discussions which dominate some of the UPSTEP classes. Probably, the one to one and a half hour activity will also provide to be more effective than activities which take longer periods of time. Thus a regular class meeting may accommodate <u>two</u> different related activities. These may be chosen so that their formats will be different from each other.

4. Some of the STEP instruments may be used in evaluation of certain activities. For example, the questionnaire described in page 17 above, may give a pretty good indication as to the effectiveness of almost any activity.

5. The format employed in the design of STEP activities appears to be very useful. It includes the following:
   a. A brief description of what the students actually do.
   b. Objectives - qualities or skills in which it is hoped they will improve as a consequence.
   c. An estimate of the time the activity takes.
   d. A list of materials needed for it.
   e. Suggested approach, or approaches.
   f. Suggested ways of estimating how much the students have learned.
   g. Comments.
6. A variety of suggestions for evaluation of students' progress and course effectiveness have been used by different teacher education programs. Some of the assignments mentioned in 2 above such as c. e, and f may be used as part of the student assessment scheme. Some suggestions may be found in the STEP materials, i.e., the questionnaire presented on Page 29. Another especially rich source of suggestions is the "evidence" column in reference 3.
7. Individual files will be kept in which a variety of data concerning the progress of each student will be collected and may serve as an important source for program evaluation, in addition to their direct value for student assessment.
8. Teaching assistants should bear the responsibility for carrying out the recommendations in 1, 6, and 7 above.
9. Some of the early evaluation studies of the teacher education program in Iowa, such as those of Golman and Pizzini may provide baselines for comparative studies of later years. Such information is very

valuable even though some of the instruments used may not meet the priorities of the present staff.

10. A higher level of cooperation between UPSTEP and other projects in the Science Education Center, such as ASSIST and Elementary School Science Teacher Education Programs, may result in a more complete set of evaluation data. The extensive field evaluation of ASSIST and the emphasis upon the research of Piaget in the elementary school program both hold promise for Iowa-UPSTEP.

11. Evaluation of the program based on graduates in the field (8, pp.74-75) together with some data collected during the course of study should yield significant information for further decisions regarding the development of Iowa-UPSTEP.

12. It is suggested that Iowa-UPSTEP will adopt the cooperative approach of STEP and, in addition to designing its own modules, will launch a major national campaign to obtain ideas and activities from science educators all over the country. In this way, not only the cost-effectiveness and rate of development of the new modules will be substantially improved, but the product will be much richer. Moreover, this procedure will pave the way for direct adoption of the modules by a responsive and sympathetic clientele.

13. A variety of instruments and measures which are currently used in the evaluation of ASSIST projects can easily be used and adapted to the evaluation of UPSTEP. This will also enable valuable comparisons to be made between pre-service and in-service teachers. The data which can easily be submitted to already existent systems of analysis will provide a valuable feedback to both instructors and trainees.

14. The talents and resources of the Measurement Center at the University of Iowa may be used to enrich the program in experiences related to assessment of student progress, especially in terms of diagnostic tests. For example, a module on the use of test results to identify students' deficiencies may be designed in cooperation with the Lindquist Center.

15. The cooperating teachers should become a more integral part of the system, so that they will be more attuned to the philosophy of UPSTEP and hence facilitate rather than hinder the development of teachers who can be described as student-centered and inquiry-oriented.

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